

SCIENCE

NEW YORK, MAY 8, 1891.

SOME POSSIBLE MODIFICATIONS IN THE METHODS OF PROTECTING BUILDINGS FROM LIGHTNING.¹

I REMEMBER with what hesitation I ventured some months ago to explain to your fellow-member, Mr. T. C. Martin, my ideas on some possible modifications in the method of protecting buildings from lightning. But as he was kind enough to express the belief that there was something in what I had to say, I have ventured to come here this evening to explain my ideas to what must be an extremely critical audience.

To begin with, I have always belonged with those who have been sceptical as to the utility of lightning-rods as ordinarily placed on our houses. I was never able to understand, and cannot now, why, if a lightning-rod as ordinarily introduced was useful, the lightning should scent out a bad earth connection at so considerable a distance. I mean that I could understand the ordinary theory of the rod if invariably the electrical discharge followed the rod as far as its conductivity was good, only to leave it when the bad earth connection was reached.

I am aware that the advocates of the old form of rod point to the apparent beneficial effects of the Harris system as introduced on ships. This may be due to the possibility of making an especially good earth connection, or it may be due to there having been introduced on ships about the time that rods were introduced some other modification which has had a beneficial effect. I have some suspicions on this point, and find it recorded in the London *Electrical Review* that lightning does not play as destructive a part as it did forty or fifty years ago, and that even those ships unprovided with conductors have suffered less damage than a smaller number of ships experienced formerly. Not that modern vessels are exempt, but they seem to be struck in a manner which causes fewer fatal accidents, and in some cases even the effects of a lightning-flash have borne so little trace of their origin that they have been credited to the wilful act of some one on board.

Ordinarily a lightning-rod is regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea is that a certain quantity of electricity has to get to the ground somehow; that if an easy channel is opened for it, the electricity will pass quietly and safely; but that if obstruction is introduced, violence and damage will result. This being the notion of what is required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod brings it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, are naturally guaranties of complete security.

I think Oliver J. Lodge has expressed well the difficulty that has always been present in my mind when I have read detailed descriptions of the effects of lightning. He says, in

a paper published in the *Electrical Engineer* some time last June, that when, in spite of all precautions, accidents still occurred; when it was found that from the best-constructed conductors flashes were apt to spit off in a senseless manner to gun-barrels and bell-ropes, and wire fences and water-butts, — it was the custom to more or less ridicule and condemn either the proprietor or its erector, or both, and to hint that if only something different had been done, — say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall, or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, — then the damage would not have happened. Every one of these excuses has been appealed to as an explanation of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

I have to say, therefore, that up to about two years ago I was simply in the dark as to what was the matter with lightning-rods. I could not accept the reasoning set forth in the report of the Lightning-Rod Conference or in any of our books. It did not seem to me that the arguments in support of the ordinary lightning-rod were logical. It seemed to me that there was something that we did not understand.

About two years ago one of the oil-tanks at Communipaw or Bayonne, just off the New Jersey Central Railroad, was struck by lightning; and, as I pass that way each day, my attention was again called to the question how we should protect our buildings from lightning; and one evening, taking up Silvanus P. Thompson's little book on electricity, I think it was, to see what he had to say about lightning, I re-read the ordinary theory of the formation of the high potentials that are manifested in lightning-discharges.

This theory is simply this: that if, in the cloud, there is a certain quantity of electricity distributed on a given mass of fine mist, it will exist there at a certain potential, depending on the capacity of this finely divided matter. Now, if these mist-particles coalesce into raindrops, the theory points out that there would be a decrease in the electrical capacity, and a consequent increase in the potential of the charge. It occurred to me immediately, that, if this theory had any foundation in fact, it ought to be possible to reverse the operation on the surface of the earth; that is, to receive the lightning-discharge on some large body, which would then be broken up into fine particles of vapor, which would have a considerably greater electrical capacity, and that the potential of the discharge would thereby be materially reduced, and the effects of the lightning mitigated. This was my hypothesis to work upon, and I immediately began to look through the records to see what actually happened in the case of lightning-discharges, and to see if there was any support in fact for my hypothesis.

The first book at hand was Sir William Thomson's "Pa-

¹ A paper, by N. D. C. Hodges, read at the fifty-sixth meeting of the American Institute of Electrical Engineers, New York, April 21.

Electricity and Magnetism," and I found that he described in detail the case of a farmhouse in Scotland, which was struck by lightning, and in which this very dissipating effect took place; that is, the bell-wires were dissipated, — an occurrence which, as you know, is extremely common when a lightning-discharge takes place. I went on through the records, and found numberless cases of this, the oldest being that of the dissipation of the metal covering on the wooden shield of some Greek warrior. I mention this case as of interest, as it brings out a very fortunate circumstance, that when thin metal is dissipated against wood or even against plaster, no harm results to the wood or plaster. Of course, you know that it has been somewhat discussed whether this action is a dissipation through the heating of the metal, or whether it is a cold dissipation — a breaking-up into particles, as it were — of the metal. On this point I have nothing to say.

But as I went on through the records I could not make the facts accord satisfactorily with my hypothesis. The dissipating action that I was looking for certainly took place, and is a very common accompaniment of lightning-discharges, but in spite of it, there was damage to the building. It was only after a considerable reading of the records that it gradually dawned on me that I had found no case where damage to the building occurred on the same level with the dissipated conductor.

Let me describe here in Franklin's own words a typical case of the action of a small conductor dissipated by the discharge.

Franklin, in a letter to Collinson read before the Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote: "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting-needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above mentioned wire, without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the aforesaid wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the ground, the building was exceedingly rent and damaged. . . . No part of the aforementioned long, small wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; the rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black, smutty track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

I would thus formulate what seems to be true, — that a conductor which can be easily dissipated by a lightning-discharge protects the building to which it is attached between two horizontal planes, the one passing through the upper

end of the dissipated conductor, and the other through the lower end; and it is this one point that I would urge upon the consideration of the Institute.

I have taken the time of the Institute to tell how I reached this conclusion; but, as must always be, I reached it by making some false digressions. So far as I know, therefore, a conductor such as I have here — a conductor made of light copper ribbon, so that seventy-five feet of it will weigh only a pound, and made in sections two feet long, which shall be tacked to the building from its ridge-pole to the foundation, the joints being made of low conductivity by the insertion of insulating washers — will protect the building. The conductor will be destroyed by the discharge. Its destruction can take place even against a plastered wall without injury to the wall; but no other harm will occur so far as the conductor extends in a vertical direction. There is no need of the conductor following the shortest course to the ground. There is no need of providing a good earth connection. I can see no difference between the two ends of the metallic ribbon. You do not attempt to make a good connection at the top with the dielectric, and I do not see why you should attempt to make a good connection at the bottom. In no case on record of the protecting influence of dissipatable conductors has this protecting influence depended upon there being a good earth connection. Of course, the ribbon should not be boarded over. Free gun-powder burns harmlessly enough, but it causes damage when burned in a confined space; and the dissipation of a conductor presents similar phenomena.

It would not do to run such a conductor as I suggest here part way down the building, and then make it turn up again before its final descent to the ground, as in such a case there would probably be a line of disaster from the point where the upward turn began.

Doubtless numerous improvements can be suggested, but letting this stand as the main point of what I have to say, — that a dissipatable conductor protects, — it may be of interest to consider why it protects. But here you will understand perfectly well that, while I can offer certain explanations which seem fairly plausible to me, it is not in the nature of things that I should have gotten at the whole truth.

In order to destroy a building in whole or in part, it is necessary that work should be done; that is, energy is required. Just before the lightning-discharge takes place, the energy capable of doing the damage which we seek to prevent exists mainly in the column of air extending from the cloud to the earth in some form that makes it capable of appearing as what we call electricity. We will therefore call it electrical energy. What this electrical energy is, it is not necessary for us to consider; but that it exists there can be no doubt, as it manifests itself in the destruction of buildings.

The problem that we have to deal with, therefore, is the conversion of this energy into some other form, and the accomplishment of this in such a way as shall result in the least injury to property and life. When lightning-rods were first introduced, the science of energetics was entirely undeveloped; that is so say, in the middle of the last century, scientific men had not come to recognize the fact that the different forms of energy — heat, electricity, mechanical power, etc. — were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known

in regard to electricity a hundred and forty years ago, and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to the dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that this electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case. The very existence of such a mass of metal as an old lightning-rod only tends to produce a disastrous dissipation of electrical energy upon its surface,—“to draw the lightning,” as it is so commonly put.

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, it seems clear why it is that the use of sufficient energy to dissipate a pound of copper, leaves not enough to do harm to other objects around. The question naturally arises how much energy there is available. There is stored up in each cubic centimetre of the column of dielectric from the cloud to the earth, just before the lightning-discharge, an amount of electrical energy given by the expression $\frac{1}{8\pi} K E^2$, where K is the specific inductive capacity of the dielectric, and E the electromotive intensity, both in electrostatic units. This expression is given on p. 156, Vol. I., second edition, of Maxwell's “Treatise on Electricity and Magnetism.” Substituting the values of K and E , and reducing, we find that the amount of energy involved amounts very nearly to one foot-pound for each cubic foot of air. This is, of course, a maximum value.

When this amount of energy is reached in any cubic foot, the air breaks down, and the discharge takes place, and the amount of energy per cubic foot in the column of dielectric reaching from the cloud to the earth cannot be uniform, but must reach this maximum value along a central core, and diminish gradually from this value to nothing at a considerable distance. If we consider that the dissipation of this electrical energy takes place throughout the whole length of the column of dielectric from the cloud to the earth, we shall see that all the energy that we have to care for in our lightning-rod is that existing in the section of the column contained between two surfaces passing through the top and foundation of our house respectively. I have said two surfaces, as doubtless they are not planes: presumably they are two equi-potential surfaces.

I am now coming to a point that I want to make clear, and that is, that, according to the usually accepted theories of electrical action, this electrical energy is gradually stored up in the column of dielectric from the cloud to the earth, and that it is distributed in this column with the greatest amount per cubic foot along some central core, this amount

not exceeding one foot-pound per cubic foot, and that this process can be continued until the stress is so great that the air breaks down, when what we call a discharge of lightning takes place, and the electrical energy disappears, of course only to take on some other form. You may say that the electricity travels from the cloud to the earth, or from the earth to the cloud, whichever you please; at any rate, there is an electrical action in a vertical direction, the discharge being supposed vertical. I will ask, however, whether it is not true that the energy involved travels along the equi-potential lines; that is, travels in the main horizontally. It seems to me that it shrinks in, as it were, from the considerable column or ellipsoid of dielectric upon the central core, where it manifests itself as heat and light in the electrical flash. It will, then, be clear how it is that in providing a body upon which the dissipation of energy shall take place we have to guard against something not coming from above or below, but coming from the side, and that this may be the explanation of why it is that, so far as I have been able to find, a dissipatable conductor protects the building between two essentially plane surfaces passing through its upper and lower ends.

Have we not, then, in the lightning-discharge, another illustration of the relation between light and electricity? If we suppose for a moment that in place of the central core where the electrical energy is dissipated we were to place some hot or luminous body, this body would constantly radiate energy into the surrounding space, and at any instant there would be in each cubic foot of this surrounding space a certain amount of radiant energy. Now, if this process could be brought to a standstill at any moment, would not the conditions be in some degree similar to those just preceding the electrical discharge? There would be need of a certain force along the central core to maintain the various stresses throughout the surrounding medium; and if this central force were to be taken away, as it is taken away when the dielectric breaks down and the spark passes, the stresses could no longer be maintained, and there would be a vibratory transmission of the energy back upon the central core.

But let all this be as it may, the main point which I would urge upon your consideration is that by giving the electrical energy something which experience shows it will readily dissipate, that is, a conductor of varying resistance and small size, we can but mitigate the effects of lightning-discharges, so long as the conservation of energy holds true. I will only repeat that I have so far found no case on record where the dissipation of such a conductor has failed to protect the building under the conditions already explained.

NOTES AND NEWS.

In England, says *The Illustrated American*, the only venomous snake is the viper, which frequents chalky districts, and is not to be found all over the country. Perhaps these vipers are the most common and vicious of the smaller snakes, seldom growing longer than two feet. They abound not only in warm countries, where forests are thick and men are few, but also in the coldest regions of Sweden, Norway, Russia, and even Siberia, where a great many exist, owing to a stupid superstition among the peasants that if a viper is killed a terrible misfortune will soon befall the rash slayer. The California viper builds itself a little mud hut, just its own length, and probably half an inch thicker than its own body. It is made of earth, fine gravel, and sometimes leaves are mixed in the construction of this curious abode. It is lined with a soft, silky substance, finer than cotton and silkier than down. At each end there are two little doors, and when *monsieur*

la maitre is half-way in, one shuts, and when all the way in, the other closes, leaving the master of the house as isolated and exclusive as Robinson Crusoe on his desert island. One of these "viper shells," brought from California lately, was so thoroughly sun-baked and hardened that though more than two feet long it could be dropped on the floor without breaking.

— A "security" elevator soon to be introduced is described as follows by a member of the Polytechnic Society of Kentucky: The framework of its hatchway is supplied, at each of the two sides or ends which stand at right angles to the cage entrance, with a pair of wood studs extending from the bottom to the top of the hatchway, and with a space of seven-eighths of an inch between them. Into one of each pair of these studs is casemented a series of horizontally arranged steel bolts ten, or it may be twelve, inches apart. These bolts are movable, and when pushed seven-eighths of an inch outward their ends project across the spaces between the studs; and as long as they remain thus across, nothing, of course, can pass up or down within these spaces. When, however, they are drawn back into their casements, the spaces are vacant, and any thing can ascend or descend through them. The framework of the cage is constructed on a central wrought iron beam, the ends of which project into these spaces. When the cage is at the bottom of the hatchway, the bolts are within their casements; but the instant its central beam passes the two bolts next to it, these, by its movement upwards, and through a device which is as immediate as it is simple and positive, are projected out of their casements across the spaces underneath the beam. When the conductor has reached any point at which he wishes to descend, he lays one of his hands against a button and through a continued pressure brings into action a device similar in nature to the one which, through the movement of the cage upward, pushed the bolts out across those spaces, and through the movement of the cage downward each successive pair of bolts next underneath are drawn back into their casements. Various ingenious devices are introduced to avoid the chance of accidental pressure on the button.

— The separation of magnetic iron-ore from the rock with which it is associated, says *Engineering*, has often been attempted with more or less success. Even if only a part of the rock is eliminated, there is a substantial gain, particularly in cases where the ore has to be transported long distances from the mine to the blast furnace. But if the gangue contain phosphorus or sulphur, as it often does, so long as any appreciable amount of it remains, the iron made from the ore is unfitted for use in the Bessemer process, and sells at a lower price than it would if it had been freed from these impurities. It has therefore been the object of inventors to produce a separator which would remove the rock so effectually that not more than .05 per cent of phosphorus should remain, even when the iron is associated with a gangue of phosphate of lime. The difficulty found was, that immediately the pulverized ore was magnetized all the particles clung together, entangling between them fragments of rock, which could only escape with difficulty, if at all. Various means were tried by vibration and alternate magnetization and demagnetization to permit the rocky particles to get away from the embrace of the metal. Whatever measure of success might be attained in this way, and the results were far from being fully satisfactory, it did not extend to the case of particles formed partly of iron and partly of rock. These were attracted by the magnet and remained with the metal. In the Monarch magnetic ore separator, however, invented by Messrs. Ball and Norton, a very ingenious method has been devised of freeing the rocky particles, and of discriminating between those that are entirely metallic, and partly metallic and partly earthy. The crushed ore is fed on to the surface of a rotating paper drum. Within this drum, and occupying less than half its circumference, is a multipolar magnet, having twelve poles alternately north and south. Immediately the metallic particles touch the drum they become polarized, and hang on by one end. In passing from the first pole to the second of the stationary magnet the opposite pole of each particle is attracted, while that hitherto attracted becomes repelled. Consequently the fragment turns end for end, and in so doing any rock clinging to it has the chance

to escape downwards under the action of gravity. This effect is repeated some twelve times. After passing half way round one drum the ore is delivered on to a second, running at a higher speed, and here centrifugal force aids the separation. The same process of turning over the fragments is repeated, and should any of them happen to be partly of rock and partly of iron they are sure to be thrown off and eliminated. The final product is almost entirely of iron, the phosphorus being reduced to .05 per cent.

— "It is, I think, well to record the following observations of the intelligence of the thrush," says John Hoskyns-Abrahall in a letter to *Nature* of April 23. "The first happened on June 28, 1865. I then saw, from the windows that look out on the little lawn north of my house, a thrush steadily 'stepping westward' in front of the hedge that parts the lawn from the public road. The bird seemed to be intentionally making for a gravel path that, after passing almost close to the windows, bends to the north-west, toward the small gate of my front garden. It was bearing something in its bill. On coming to the path it attempted to break this on a stone. It did not succeed. It then tried another stone. This time it succeeded. Thereupon it flew away. On the spot I found a remarkably big stone embedded in the path, and round it were scattered bits of snail shell. The bird had eaten the snail. The second of the observations I would note, and the more striking of the two, happened on June 5, 1890. I then was viewing the gravel path from the westernmost of the four windows. Just beneath me, standing on the path, was a female thrush. She had succeeded in breaking a snail shell. She had the snail in her bill. But, despite of vigorous efforts, she could not swallow it. Up hopped a male thrush. Standing before the female, he opened his bill. She dropped the snail into his bill. He chewed the snail. He dropped it back into the female's ready bill. She swallowed it. The pair blithely trotted off, side by side, toward the small gate. I saw them no more."

— Mr. W. H. Goodyear, writing to the *New York Nation* from Kenh, Upper Egypt, on March 17, says that Mr. Petrie has unearthed at Maydoom "the oldest known Egyptian temple and the only Pyramid temple ever found." Apart from the Temple of the Sphinx at Ghizeh, this building is also "the only temple of the Old Empire so far known." It was buried under about forty feet of rubbish. It lies directly at the centre of the eastern base of the Pyramid, on the side facing which it has two round-topped obelisks. "Obelisks and temple chambers so far entered," says Mr. Goodyear, "have the plain, undecorated style of the Old Empire, as shown by the Temple of the Sphinx, but hieratic inscriptions in black paint found within fix the name of Seneferoo as builder, and confirm the supposition to this effect hitherto based on the fact that tombs near the Pyramid contain his cartouche. Seneferoo is the king connecting the third and fourth dynasties, and variously placed in either. According to computations of Mariette and Brugsch, the antiquity will be about 4000 B.C., or earlier." On Tuesday, March 10, Mr. Petrie's workmen reached a platform which appeared to be a causeway terminating with two obelisks at the base of the Pyramid. "In the forenoon of Wednesday," continues Mr. Goodyear, "a workman came to say that an opening had been found under the platform on the side next the Pyramid. This proved to be the top of a doorway choked by detritus, through which Mr. Petrie crawled into an interior of three chambers and discovered the inscriptions mentioned. I had the pleasure of following him. Mr. Petrie thought the apartments had not been previously entered for about three thousand years — that is to say, that the rubbish fallen from the pyramid had choked the entrance about three thousand years after construction. A friend who was with me noticed on the floor some dried wisps of papyrus, a plant now extinct in Egypt. The chambers thus far found are so filled that one cannot stand erect in them, and a door at the end of the third chamber is blocked by large stones. Over all lies an enormous mass of detritus, whose removal by Arab diggers is now in progress. I had the pleasure next day of carrying the news of Mr. Petrie's find to the gentlemen of the Egypt Exploration Fund at Beni-Hassan, and of witnessing their unaffected delight over it."

—The United States Hydrographic Office reports that this month, for the first time in several years, there is not a single obstruction along the coast that is dangerous to sea-going vessels, thanks to the work of the United States Steamship "Yantic," in command of Commander C. H. Rockwell, U.S.N. The last wreck destroyed was the schooner "Ada P. Gould," near Cape Charles light-ship, April 11 and 12, and a final visit was paid on April 24 to the scene of the collision between the "Vizcaya" and "Hargraves," off Barnegat. The "Yantic" has been engaged in this work for seventy-six days, of which thirty-six were spent at sea. She has steamed and sailed about 3,000 miles and has anchored in the open sea, in various depths along the coast, twenty-two times. Six wrecks have been destroyed, one has been dismantled, and a permanent danger mark erected; many spars have been blown up and set adrift, and five wrecks have been sought for with care and reported as no longer existing as obstructions. Thirty-three service torpedoes and seven exercise torpedoes have been expended in the work, and no casualties or accidents of any kind have occurred. The following is an extract from Commander Rockwell's report: "Officers and crew were carefully instructed and prepared for this hazardous and important duty, and strong wrecking crews were detailed from the best men in the ship for the working boats. There was always danger of staving a boat, and our boats received considerable injury and hard usage in this way, but by practice the men became very expert, and were generally successful in avoiding danger. I take pleasure in commending officers and men for their zeal and earnestness."

—Capt. Petersen, of the Swedish bark "Eleanora," reports to the United States Hydrographic Office that between 7 and 8 P.M., March 13, he experienced a submarine earthquake in the volcanic region of the Atlantic west of St. Paul Rocks. The ship was heading north-west, going about three knots, with a light easterly wind and calm sea, when a noise was heard on the port side, like a heavy surf, and almost immediately the sea began to bubble and boil like a huge kettle, the broken water reaching as high as the poop-deck. No distinct shock was felt, but after the disturbance struck the ship she continued to tremble as long as it lasted. After about an hour it ceased for an hour and was then followed by another similar disturbance. A bubbling sound was all that could be heard and the water appeared foamy, but it was impossible, on account of the darkness, to say whether it was muddy. The next day weather and sea were as usual. Position at 8 P.M., 3° 47' north latitude, 42° 03' west longitude. The region from St. Paul Rocks to and including the Windward Islands is especially subject to earthquakes, and reports similar to the above are often received. In September, October, and November of last year a number of shocks were reported, of which the heaviest was the one at Barbadoes on Oct. 6, felt throughout the region between Demerara and Martinique. On Nov. 20, a severe shock was felt about 8° 45' north latitude, 40° 28' west longitude, aboard the American bark "P. J. Carleton," Capt. Crosbie. The sea became like a boiling pot, tumbling about in a seething mass and greatly confused, and a grating sensation was experienced, as though the vessel were going over a reef. Nov. 28, in 3° 00' north latitude, 27° 00' west longitude, a slight shock was experienced aboard the British ship "Walter H. Wilson," Capt. Sproul.

—John Le Conte, professor of physics at the State University, Berkeley, Cal., died April 29. Dr. Le Conte belonged to a family distinguished for having many members who have been interested in scientific work. He was the son of Lewis Le Conte, known for his contributions to the physical sciences as well as a naturalist, and was born in Liberty County, Ga., in December, 1818. He was graduated at Franklin College of the University of Georgia in 1838, and at the New York College of Physicians and Surgeons in 1841. From this city he proceeded to Savannah, where he began the practice of the medical profession, but in 1846 he was called to the chair of Natural Philosophy in Franklin College, which he occupied until 1855. The following year he lectured on chemistry at the New York College of Physicians and Surgeons, and in 1856 he was appointed Professor of Natural and Mechanical Philosophy in South Carolina College, at Columbia, S.C. In 1869 he was ap-

pointed Professor of Physics and Industrial Mechanics in the University of California, and discharged the duties of that position until 1881. From 1876 to 1881 he held the office of president of the university in connection with his professorship. At the expiration of that period he retired to the chair of physics, which he occupied until his death. He was a brother of Professor Joseph Le Conte, the geologist.

—Dr. Joseph Leidy died April 19. Dr. Leidy was born in Philadelphia, Sept. 9, 1823. In 1844 he received the degree of doctor of medicine from the University of Pennsylvania, but soon abandoned the practice of his profession for more congenial pursuits. From 1846 to 1852 he gave private lectures on anatomy and physiology. In 1853 he was made professor of anatomy in the University of Pennsylvania, a position in connection with which he did the major part of his scientific work. Aside from his work in anatomy he did much in zoölogy and paleontology. In 1884 Dr. Leidy was made director of the biological department in the university. As an indication of the extent of his investigations it may be mentioned that his papers on biological subjects number more than eight hundred.

—Freiherr von Benko, captain in the Austrian Navy, has published a pamphlet, we learn from the April *Scottish Geographical Magazine*, in which he calls attention to the singular fact that until half a century ago the inhabitants of the Philippines were a day behind those of neighboring countries in their reckoning. It is easy to understand that the time on the meridian opposite to ours must differ by twelve hours, but who shall say whether those twelve hours are to be added or subtracted from our reckoning? Practically this has generally been settled by the first discoverers, according as they sailed eastwards or westwards. Legaspi, the conqueror and colonizer of the Philippines, sailed to the islands from the east, and brought what may be called the eastern date with him. Later on, however, when the Pope divided the world between the Spaniards and the Portuguese, giving the former the half lying beyond a meridian passing 100 leagues west of the Azores (afterwards removed to 370 leagues) the islands, owing to the inability of navigators in those days to calculate the longitude with any approach to accuracy, remained in the hands of the Spaniards, and the date was changed to that of their American possessions. But, in 1844, the governor-general of the Philippines decreed that "considering it convenient that the mode of reckoning days in these islands shall be uniform with that prevailing in Europe, China, and other countries situated to the east of the Cape of Good Hope, . . . I ordain, with the assent of His Excellency the Archbishop, that, for this year only, Tuesday, December 31st, be suppressed, and that the day following Monday the 30th of the same month be styled Wednesday, January 1st, 1845." That the date has been made to conform with that of Eastern countries is a circumstance not generally known, as Freiherr von Benko proves by quotations from geographical authors and encyclopædias, among others Meyer's "Konversation Lexikon."

—So far as is at present known, says *Nature*, the first person who kept a record of the weather was Walter Merle. He did so for the years 1337 to 1344, and his manuscript on the original vellum still exists. Thanks to the courtesy of the officials of the Bodleian Library, Mr. G. J. Symons has had this manuscript photographed, and reproductions of the ten large photographs, with a full translation (the original is in contracted Latin), some particulars as to Merle, and a list of the subscribers, are to be given in a handsomely printed volume. Mr. Symons wishes to call attention to the fact that no one will be able to obtain a copy who does not apply for one before May 1. Except ten copies reserved for subscribers too distant to apply before that date, not a single copy in excess of those subscribed for will be printed.

—Mr. William Beutenmüller has recently been appointed curator of the department of entomology in the American museum of natural history in Central Park, New York City.

—Mr. C. H. Tyler Townsend has just taken the post of entomologist at the agricultural experiment station at Las Cruces, New Mexico.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

SORGHUM AND SUGAR BEETS IN KANSAS.

THE Agricultural Experiment Station at Manhattan, Kan., has been engaged for three years in a series of investigations upon sorghum, the principal aims being: (a) the attempt to find better varieties of sorghum for producing sugar; (b) to improve well-known and approved sorts; (c) to secure both early and late maturing kinds of good quality, especially the former, in order to lengthen the working season.

Bulletin 16 of this station, for December, 1890, gives the results of this work for 1890, including comparative tests of a large number of varieties, with analysis of their juice; attempts to improve seed by selection, trials of fertilizers, and a study of smut in sorghum. The same station has also established a series of experiments in the comparative culture of sugar beets, the results of 1890 being given in the bulletin referred to. The season was unfavorable to both sorghum and sugar beets, on account of both heat and drought.

Following is the station's summary of the results obtained as to sorghum.

1. The season of 1890 was very unfavorable to sorghum, owing to deficient rainfall and intense heat during the early summer, followed by cool, wet weather, culminating in an unprecedented killing frost Sept. 13. This frost was so exceptional as to date, and so erratic in distribution, its limit bearing no relation to isotherms or latitude, that it gives no ground for the conclusion that it was too far north for successful sugar manufacture from sorghum. Notwithstanding this, the tables show that the standard varieties maintained a good, though lower, standard of excellence.

2. The selection of seed with a view to improvement of varieties was almost wholly prevented by the early frost. A comparison of the results obtained for three years in selection of specially good canes lends encouragement to the hope that the standard of sugar-content may be permanently raised by this means.

3. A comprehensive experiment to test the effect of fertilizers on sorghum has shown no marked results this year, as was to be expected in view of the conditions of growth. The experiment will be continued from year to year, the same fertilizers being applied to the same plot throughout.

4. In view of the occurrence of two varieties of smut in the plots this year, caution in the introduction of new varieties is urged, lest destructive contagious diseases be brought in at the same time.

5. Crossing of varieties deteriorates the crop, so far as the experiments have gone.

The results of the experiments with sugar beets are as follows.

1. The sugar beets grown do not appear to be of as good quality as those reported to have been produced in other parts of Kansas and in Nebraska. This may have been due to the unusually unfavorable climatic conditions of last summer, or to unsuitability of soil.

2. Analysis of individual beets indicated that maturity, more than size, determined the sugar-content of the beet. A brown epidermis accompanied high per cent of sugar. As far as the observations went, a high weight of leaves, as compared with the roots, was no evidence of high sugar-content, but rather the reverse.

THE MERCURIAL PRESSURE-GAUGE ON THE EIFFEL TOWER.

THE new mercurial pressure-gauge devised by M. Cailletet and erected at the Eiffel Tower is an instrument of much scientific interest. The only instruments by which high pressures in gases or liquids can be registered with accuracy are very long vertical pressure-gauges. A gauge of this type, more than three hundred feet in height, was set up by M. Cailletet some years ago, first on the side of a hill, and afterwards in an artesian well. Several scientific men imitated this method of gauging high pressures, but the difficulty of handling and experimenting upon an instrument under conditions so unfavorable, threw considerable doubt upon the accuracy of the results obtained. The Eiffel Tower afforded a unique opportunity for setting up a pressure-gauge 984 feet high, every part of which should be accessible and open to observation. Thanks to the liberality of M. Eiffel, says *Engineering*, the task of constructing and fixing an instrument on so gigantic a scale has actually been now accomplished.

With a gauge of this height pressure up to four hundred atmospheres can be obtained, but it is manifestly impossible to use the customary glass tube. Recourse has, therefore, been had to a tube of soft steel of about one-sixth of an inch internal diameter, connected at the bottom of the tower with a reservoir containing mercury. By pumping water into the reservoir, the mercury in the tube can be gradually raised to the top of the tower.

A difficulty, however, arose from the slanting position of the columns supporting the tower, which prevented the tube being vertical. From the base of the tower to the first platform, a height of about 197 feet, the tube was therefore placed against the inclined plane of one of the rails of the lift, an iron staircase running beside it. Between the first and second platforms, which are separated by about the same interval, the apparatus was fixed to one of the helicoidal staircases. As this staircase is divided into several sections, not in the same vertical plane, on account of the obliquity of the column, the tube is similarly divided, and bends as it passes from one staircase to the other, sufficient slope being allowed for the descent of the mercury when the pressure is reduced. From the second platform to the top the tube is arranged in the same way, following the two vertical staircases, and is thus easily accessible from top to bottom.

The steel tube being opaque, the level of the mercury cannot be directly read off. Cocks with conical screws, each communicating with vertical glass tubes, are arranged at equal distances, about every ten feet, parallel with and alongside the tube. Each glass tube has a scale, carefully marked off on polished wood, which has been selected because it is very slightly affected by changes of temperature. It is adjusted by a rubber band to the metal framing, and leather rings compressed by a screw keep the cock tight. When one of the cocks is opened the interior of the steel tube is placed in communication with the corresponding glass tube. As the mercury rises in the steel tube, it penetrates into and acquires the same level in the glass tube alongside.

From the bottom of the tower to the first platform, the steel tube, as already mentioned, is in an inclined position, and the series of glass tubes placed vertically across it. These sections of glass tube are about ten feet long, each furnished with its scale and the cock communicating with the main steel tube; thus the pressure in any given glass tube is limited to its length of ten feet. The scales are marked in metres and centimetres, so that the head

may be read with the utmost accuracy. The tubes and scales are protected from the weather by wooden hinged casings, which can be opened at will.

To obtain a given height or pressure at a given moment, the cock of the corresponding glass tube must be opened, and the hydraulic pump set to work. When the mercury reaches the cock, it rises at the same time in both the steel and the glass tube. By working the hydraulic pump slowly, it can be brought exactly up to the required level, but if the mark be overshot, a certain quantity of water under pressure is allowed to escape near the pump at the bottom. This arrangement is carried out in the laboratory at the foot of the tower. The necessary communication between the two operators, one at the bottom and the other at any required height, is effected by means of a telephone which the ascending or descending operator carries with him, and through which he can speak with those in the laboratory below. If the mercury rises by mistake above the top of any one of the glass tubes it returns to the foot of the tower through an overflow pipe.

As the graduated scales behind each glass tube are not always vertically superposed, their readings are harmonized by means of two connected reservoirs of water joined by an India-rubber tube. The horizontal plane for the base of each scale corresponding to the upper level of the preceding scale can be ascertained from this artificial level.

A laboratory has been erected in the west pillar of the tower, containing the hydraulic force pump, the mercury reservoir, the telephonic station, and other accessories. Among these is a metal gauge of large dimensions connected with the mercury under pressure. It is marked to scale to show first the pressure in atmospheres, and second the numbers corresponding to the different cocks up the tower. The operator is thus able to tell at once and beforehand into which glass tube the mercury ought to rise under a given pressure, and the right cock to get opened to show the level it has reached. To calculate the pressure according to the height to which the column of mercury is raised, the mean temperature of the column in each experiment must be found. This is done by measuring the variation in the electric resistance communicated by the column to the telephonic wire.

The apparatus here described will be found of the greatest use for making experiments on pressures hitherto impossible, and its value from a scientific point of view can scarcely be overrated. The thanks of all scientific men are due to M. Eiffel, who generously undertook the whole expense of constructing and setting up the pressure-gauge, and also to M. Cailletet, to whose skilful designs the success obtained is chiefly due.

PRECIOUS AND ORNAMENTAL STONES AND DIAMOND CUTTING.¹

UP to the present time there has been very little mining for precious or semi-precious stones in the United States, and then only at irregular periods. It has been carried on during the past few years at Paris, Me.; near Los Cerrillos, N. Mex.; in Alexander County, N.C., from 1881 until 1888, and on the Missouri River near Helena, Mont., since the beginning of 1890. True beryls and garnets have been frequently found as a by-product in the mining of mica, especially in Virginia and North Carolina. Some gems, such as the chlorastrolite, thomsonite, and agates of Lake Superior, are gathered on beaches, where they have fallen from rock which has gradually disintegrated by weathering and wave action.

A very limited number of diamonds have been found in the United States. They are met with in well-defined districts of California, North Carolina, Georgia, and recently in Wisconsin, but up to the present time the discoveries have been rare and purely accidental.

Of the corundum gems (sapphire, ruby, and other colored varieties) no sapphires of fine blue color and no rubies of fine red color have been found. The only locality which has been at all prolific is the placer ground between Ruby and Eldorado bars, on the Missouri River, sixteen miles east of Helena, Mont. Here

sapphires are found in glacial auriferous gravels while sluicing for gold, and until now have been considered only a by-product. Up to the present time they have never been systematically mined. In 1889 one company took the option on four thousand acres of the river banks, and several smaller companies have since been formed with a view of mining for these gems alone or in connection with gold. The colors of the gems obtained, although beautiful and interesting, are not the standard blue or red shades generally demanded by the public.

At Corundum hill, Macon County, N.C., about one hundred gems have been found during the last twenty years, some of good blue color and some of good red color, but none exceeding \$100 in value, and none within the past ten years.

Of the beryl gems (emerald, aquamarine, and yellow beryl) the emerald has been mined to some extent at Stony Point, in Alexander County, N.C., and has also been obtained at two other places in the county. Nearly every thing found has come from the Emerald and Hiddenite mines, where during the past decade emeralds have been mined and cut into gems to the value of \$1,000, and also sold as mineralogical specimens to the value of \$3,000; lithia emerald, or hiddenite, to be cut into gems, \$8,500, and for mineralogical specimens \$1,500; rutile, cut and sold as gems, \$150, and as specimens, \$50; and beryl, cut and sold as gems, \$50. At an altitude of 14,000 feet, on Mount Antero, Colorado, during the last three years, material has been found which has afforded \$1,000 worth of cut beryls. At Stoneham, Me., about \$1,500 worth of fine aquamarine has been found, which was cut into gems. At New Milford, Conn., a property was extensively worked from Oct., 1885, to May, 1886, for mica and beryl. The beryls were yellow, green, blue, and white in color, the former being sold under the name of "golden beryl." No work has been done at the mine since then. In 1886 and 1887 there were about four thousand stones cut and sold for some \$15,000, the cutting of which cost about \$3,000.

Turquoise, which was worked by the Aztecs before the advent of the Spaniards and since then by the Pueblo Indians, and largely used by them for ornament and as an article of exchange, is now systematically mined near Los Cerrillos, N. Mex. Its color is blue, and its hardness is fully equal to that of the Persian, or slightly greater, owing to impurities, but it lacks the softness of color belonging to the Persian turquoise. From time immemorial this material has been rudely mined by the Indians. Their method is to pour cold water on the rocks after previously heating them by fires built against them. This process generally deteriorates the color of the stone to some extent, tending to change it to a green. The Indians barter turquoise with the Navajo, Apache, Zuni, San Felipe, and other New Mexican tribes for their baskets, blankets, silver ornaments, and ponies.

The finest garnets and nearly all the peridots found in the United States are obtained in the Navajo Nation, in the north-western part of New Mexico and the north-eastern part of Arizona, where they are collected from ant-hills and scorpion nests by Indians and by the soldiers stationed at adjacent forts. Generally these gems are traded for stores to the Indians at Gallup, Fort Defiance, Fort Wingate, etc., who in turn send them to large cities in the east in parcels weighing from half an ounce to thirty or forty pounds each. These garnets, which are locally known as Arizona and New Mexico rubies, are the finest in the world, rivaling those from the Cape of Good Hope. Fine gems weighing from two to three carats each and upward when cut are not uncommon. The peridots found associated with garnets are generally four or five times as large, and from their pitted and irregular appearance have been called "Job's tears." They can be cut into gems weighing three or four carats each, but do not approach those from the Levant either in size or color.

Since the discovery of gold in California compact gold quartz has been extensively used in the manufacture of jewelry, at one time to the amount of \$100,000 per annum. At present, however, the demand has so much decreased that only from five to ten thousand dollars' worth is annually used for this purpose. In addition to the minerals used for cabinet specimens, etc., there is a great demand for making clocks, inkstands, and other objects.

During the year 1887 about half a ton of rock crystal, in pieces

¹ From Census Bulletin No. 49, by George F. Kunz.

weighing from a few pounds up to one hundred pounds each, was found in decomposing granite in Chestnut Hill township, Ashe County, N.C. One mass of twenty and one-half pounds was absolutely pellucid, and more or less of the material was used for art purposes. This lot of crystal was valued at \$1,000.

In Arkansas, especially in Garland and Montgomery Counties, rock crystals are found lining cavities of variable size, and in one instance thirty tons of crystals were found in a single cavity. These crystals are mined by the farmers in their spare time, and sold in the streets of Hot Springs, their value amounting to some \$10,000 annually. Several thousand dollars' worth are cut from quartz into charms and faceted stones, although ten times that amount of paste or imitation diamonds are sold as Arkansas crystals.

Rose quartz is found in the granitic veins of Oxford County, Me., and in 1887, 1888, and 1889 probably \$500 worth of this material was procured and worked into small spheres, dishes, charms, and other ornamental objects.

The well-known agatized and jasperized wood of Arizona is so much richer in color than that obtained from any other known locality that, since the problem of cutting and polishing the large sections used for table tops and other ornamental purposes was solved, fully \$50,000 worth of the rough material has been gathered and over \$100,000 worth of it has been cut and polished. This wood, which was a very prominent feature at the Paris Exposition, promises to become one of our richest ornamental materials.

Chlorastrolite in pebbles is principally found on the inside and outside shores of Rock Harbor, a harbor about eight miles in length on the east end of Isle Royale, Lake Superior, where they occur from the size of a pin head to, rarely, the size of a pigeon's egg. When larger than a pea they frequently are very poor in form or are hollow in fact, and unfit for cutting into gems. They are collected in a desultory manner, and are sold by jewelers of Duluth, Petoskey, and other cities, principally to visitors. The annual sale ranges from \$200 to \$1,000.

Thomsonite in pebbles occurs with the chlorastrolite at Isle Royale, but finer stones are found on the beach at Grand Marais, Cook County, Minn. Like the chlorastrolites, they result from the weathering of the amygdaloid rock, in which they occur as small nodules, and in the same manner are sold by jewelers in the cities bordering on Lake Superior to the extent of \$200 to \$1,000 worth annually.

In New York there are sixteen firms engaged in cutting and recutting diamonds, and in Massachusetts there are three. Cutting has also been carried on at times in Pennsylvania and Illinois, but has been discontinued. In 1889 seven of the New York firms ran on full time, but the others were unemployed, respectively, 14, 50, 61, 120, 125, and 240 days, owing to inability to obtain rough material at a price at which it could be advantageously cut. The firms that were fully employed were generally the larger ones, whose business consisted chiefly in repairing chipped or imperfectly cut stones, or in recutting stones previously cut abroad, which, owing to the superior workmanship in command here, could be recut at a profit, or in recutting very valuable diamonds when it was desired, with the certainty that the work could be done under their own supervision, thus guarding against any possible loss by exchange for inferior stones.

The industry employed 236 persons, of whom 69 were under age, who received \$148,114 in wages. Of the nineteen establishments, sixteen used steam power. Foot power is used in only one establishment. Three of the firms are engaged in shaping black diamonds for mechanical purposes, for glass cutters and engravers, or in the manufacture of watch jewels.

Beginning in the latter part of 1888, and through 1889, there was a marked increase in the price of rough diamonds, resulting in rapid advances of from 20 to 25 per cent at a time, amounting in all to an advance of from 80 to 100 per cent above the prices of the previous years.

The importation of rough and uncut diamonds in 1880 amounted to \$129,207, in 1889 to \$250,187, and the total for the decade was \$3,133,529, while in 1883 there were imported \$443,996 worth, showing that there was 94 per cent more cutting done

in 1889 than in 1880, but markedly more in 1882 and 1883. This large increase of importation is due to the fact that in the years 1882 to 1885 a number of our jewelers opened diamond-cutting establishments, but the cutting has not been profitably carried on in this country on a scale large enough to justify branch houses in London, the great market for rough diamonds, where advantage can be taken of every fluctuation in the market and large parcels purchased, which can be cut immediately and converted into cash; for nothing is bought and sold on a closer margin than rough diamonds. There has been a remarkable increase in the importation of precious stones in this country in the last ten years. The imports from 1870 to 1879, inclusive, amounted to \$26,698,203, whereas from 1880 to 1889, inclusive, the imports amounted to \$87,198,110, more than three times as much as were imported the previous decade.

THE PENINSULA OF KAMTCHATKA.¹

THOUGH this country passed in 1696 into the hands of the Russians, it is still one of the least known parts of their empire. Professor Unlauff gives its area as 104,200 square miles. It is traversed along its whole length by a mighty chain of mountains, which rise into the regions of eternal snow. On the eastern side are numerous volcanoes, of which twenty-one are now active. Dittmar's map (1850) shows only twelve active volcanoes, from which it may be inferred that the subterranean forces have developed a large amount of energy since his time. At the southern extremity of the peninsula numerous isolated volcanic cones rise from the low ground, of which the Apatcha only is active. To the north of this mountain the country begins to rise, and at length two chains are formed, of which the western extends through the whole peninsula. Only one volcano, the Icha, is situated actually within the range, but several others lie between it and the western coast. Below the 57th parallel the river Tigil has eroded a narrow valley through the range, and a little further north a deep depression interrupts the continuity, but the elevation soon increases again, and is continued in the Voyampolka Mountains. The eastern range is far shorter, extending only to the 55th parallel. It also contains only one volcano; but the short range which runs off from it in a south easterly direction to Cape Shipunskie contains several, among them the Koryaka, which attains a height of 11,218 feet. They are particularly numerous in the elevated country which adjoins the eastern range, and entirely fills the space between the middle and lower Kamtchatka River and the eastern coast. Here stands the Klutshef, the culminating summit of the peninsula, 15,757 feet high. On the left bank of the Kamtchatka the Timaska, a low chain with rounded summits, runs eastward, and is joined on the north by the Novikofskaja Vershina, ending in Cape Stolbovi. Beyond the 57th parallel northwards there is only the one range. Numerous hot springs testify to the volcanic character of the eastern part of Kamtchatka. Dittmar found the temperature of a spring near the Mikishina to be 120° F. on Dec. 16th, when the temperature of the air was -11°. Owing to the great atmospheric moisture and the abundant rainfall, the country is irrigated by numerous rivers, of which the Kamtchatka is the largest. The Shupanof, on the east, and the Bolshaya Icha, and Tigil, on the west, are also important streams. The climate is changeable and severe, and much colder than that of countries in the same latitude on the other side of the Old World. When Dittmar visited the country, there was ice in May on an inlet of Avatcha Bay, and on the west coast, which is much colder, the thermometer stood at sunrise on Aug. 2d at about 34° F. In winter, temperatures of -40° and lower were recorded. The snow-line lies at a height of about 5,300 feet.

In Kamtchatka, as in central Siberia, the vegetation is surprisingly exuberant. Rich meadow-land alternates with dense woods, composed, in the south, of poplars, willows, and birches. Where the woods are thin, bushes grow freely, and flowering plants bedeck the ground. Wild animals are abundant, and hunting and fishing are the chief means of procuring food. The most important game are wild reindeer, wild sheep, hares, otters, sables, and ermine. Bears, wolves, and foxes are also numerous. Of birds, heathcock,

¹ From the Scottish Geographical Magazine, April, 1891.

swans, geese and ducks, and sea-fowl may be mentioned. In the southern rivers salmon is plentiful.

The southern part of the peninsula is inhabited by Kamtchadales, numbering some 4,000 souls. They have submitted to Russian influence, and are Christians in name, but still cling to the rites of Shamanism. Their mud huts have given place to houses, round which gardens are laid out. They keep cattle and a few horses and fowls, but neither sheep nor pigs. In the north about 3,000 Koriaks live, who are still in a primitive state, and subsist on the produce of the chase and fishing. Their most important domestic animals are dogs, which draw their sleighs.

THE MEAN COAST-DISTANCES OF CONTINENTS.

THE proximity of countries to the sea has a most important bearing on their climate, commercial development, etc., and therefore the problem of ascertaining the relative advantages in this respect of different parts of the world has long attracted the attention of geographers. In *Petermann's Mittheilungen*, Bd. 36, Nos. 3 and 4, Dr. Carl E. M. Rohrbach explains a new method of solving the problem, in which the mean distances of the continental lands from the coast play an important part. As quoted in the *Scottish Geographical Magazine*, he shows, as a preliminary investigation, that the mean distance of a circle from the circumference is one-third the radius, and that this distance is the same for a square, or other rectilinear figure, circumscribing the circle. It is found by integrating the product of an elementary area into its distance from the perimeter and dividing by the whole area. The process is, therefore, similar to that of finding the centre of gravity of the area, and, accordingly, the value may be very simply found by dividing the circle or square into indefinitely small triangles by radii drawn from the centre, the centres of gravity of which are, of course, at one-third of the radius from the perimeter. From this result Dr. Rohrbach deduces the mean distance for a rectangle, and shows how to find it for a *calotte*, or the spherical area contained by a small circle of a sphere. Even for a large *calotte* it differs very little from that of a circle of equal area. These investigations prove that of all figures containing the same area the circle and its circumscribed figures are those in which the distances from the perimeter are greatest, and this proposition is exhibited in a convenient form by means of curves, in which the abscissæ are proportional to the areas, and the ordinates to the distances from the perimeter. In the diagram thus constructed the curve (a parabola, of course) for the circle lies outside all the others, and as the area deviates more and more from the circular form, its curve approximates more closely to a straight line. Owing to this property the circle gives a convenient standard for mean distance from the coast, as will be seen presently.

In dealing with continental areas Dr. Rohrbach draws contour-lines on a map parallel to the coast-line at certain chosen intervals, and measures the areas contained with a planimeter. If great accuracy be desired, the lines must be traced on a map in which there is no distortion, and then transferred for measurement to an equal-area map, but in a first essay, to demonstrate the applicability of the method and the value of its results, Dr. Rohrbach considered Bonne's projection sufficiently accurate for tracing the lines as well as for measurement. A map of the world and another of Europe are appended to the article, on which the contour-lines are drawn, and the coast-distance of the areas between them denoted by different colors. The relative conditions of the continents are also shown, both by rectangles of which the bases are proportional to the areas, and the altitudes to the mean coast-distances, and also by curves — *chorigraphic*, as Dr. Rohrbach calls them — where the ordinates represent the coast-distances corresponding to the areas indicated by the abscissæ. Tables are given showing the areas lying beyond different distances from the coast in the various continents, both in square kilometres and in percentages. The following shows the mean coast-distances: Europe, 208 miles; Asia, 482 miles; Eurasia, 433 miles; Africa, 417 miles; Australia, 214 miles; North America, 292 miles; South America, 343 miles; the five continents, 381 miles.

As a measure of the accessibility of continents from the coast, Dr. Rohrbach proposes the quotient obtained by dividing the

mean distance in a circle, or in a *calotte*, of equal area by the actual mean distance, and gives the numbers in the latter case, but the result is scarcely satisfactory. As he himself points out, Eurasia appears to greater advantage than Europe, because the mean distance in the *calotte* is calculated as though sea instead of land lay to the east, and thus the quotient is increased. It is also startling to find North America represented by a higher figure than Europe, and the five continents by a number more than twice as great. It is easy to see that these discrepancies arise because the numbers represent only the advantage each continent derives from its actual shape compared with its accessibility if formed into a *calotte*, and do not indicate the relative accessibility of the continents. A more correct idea is obtained by taking the mean coast-distance (1,416 miles) in a *calotte* of area equal to that of the five continents, or the actual mean distance (381 miles), as unity. In the latter case the numbers are as follows: Europe, 1.83; Asia, 0.79; Eurasia, 0.88; Africa, 0.91; Australia, 1.78; North America, 1.30; South America, 1.11; the five continents, 1.00.

Dr. Rohrbach claims that his method is superior to those before employed, because the mean coast-distance is a quantity admitting of simple definition, and not deduced by any artificial means from the geometrical forms. Its value also is easily reckoned, and can be worked out to any desired degree of accuracy, maps of various scales being employed according to the extent and configuration of the countries under examination. In almost all other methods the length of the coast-line has been used, the estimation of which leaves much room for speculation, causing great uncertainty in the results. In the present method this quantity is not needed, and yet the meanderings of the coast-line exercise their due influence on the curvature of the contour-lines, as may be clearly seen on the map of Europe already alluded to. And not only is the method applicable to purely morphological investigations, but charts may also be constructed, showing the relative conditions of the various parts of a country with regard to means of communication. Thus, an ice-bound coast may be treated as an inland boundary, and, where a chain of mountains intervenes, the contour-lines may be drawn so that their normals run to the sea past the extremities of the chain, or converge to the passes. Navigable rivers, railways, etc., may also be taken into account, and also the elevation, etc., charts being constructed to show the work required to transport a unit weight of goods, say a hundred-weight, from the coast. Each contour-line in such charts will pass through all places to which the labor of transport is the same, and will therefore resemble an isobar or isotherm.

BOOK-REVIEWS.

Grammatica elementar do Kimbundu. Kimbundu Grammar. Por HELI CHATELAIN. Genebra, 1889.

La Lengua Cunza. Por FRANCISCO DE SAN-ROMAN. Santiago de Chile, 1890.

Kreolische Studien. Ueber das Malaisportugiesische von Batavia und Tugu. Von HUGO SCHUCHARDT. Vienna, 1891.

Etudes de Grammaire Comparée. De la Catégorie des Modes. Par RAOUL DE LA GRASSERIE. Louvain, 1891.

THIS batch of recent linguistic works, in widely diverse fields, is but a faint indication of the activity in this branch of scientific research.

Mr. Chatelain has been connected with the American mission in south-west Africa, and his grammar of the Kimbundu, a member of the wide-spread Bantu group, has particular interest, not only for its practical value in missionary work, but because the Smithsonian Institution is about to publish the author's collections of folk tales and legends in the original tongue, together with translations and notes.

The Cunza language is spoken by a native tribe on the south-west coast of South America, at the northern border of the Desert of Atacama. It is supposed by the eminent linguist von Tschudi to be the ancient Calchaqui. Although San Roman does not furnish a full grammatical view of the tongue, we are glad to have even his incomplete notes, as heretofore there has been absolutely nothing on its grammatic structure.

Professor Hugo Schuchardt is the most distinguished student living of mixed languages or "jargons," and his researches into their structure have been prolific of valuable results. The above is but one — the ninth — of his numerous "Creole Studies." It is one of the most instructive, as exhibiting the results of the commingling of the Portuguese with the Malayan languages, which are particularly widely apart. Like all his essays, it is replete with erudition, and marked by soundness and caution in handling facts.

The logical processes underlying language in general have been analyzed in a number of essays by Dr. Raoul de la Grasserie in his "Studies in Comparative Grammar." He has taken up in turn such topics as "the substantive verb," "pronouns," "tenses," etc., and striven to show by a very wide induction how these fundamental grammatical notions arose in the mind, and in what varied forms they sought expression in speech. The study above referred to, on "the category of moods" extends these comparisons to that feature of the verb. It is a masterly application of the principles of psychology to the evolution of language.

The Elements of Dynamic Electricity and Magnetism. By PHILIP ATKINSON. New York, Van Nostrand. 405 p. 8°.

As this is intended more for learners than for the learned, it appeals to a larger circle than do many other works on the subjects treated, and, for the same reason, mathematical formulæ are conspicuous by their absence. Mathematical reasoning, where required, has been, so far as possible, rendered intelligible to non-mathematical readers by the use of ordinary language and some unavoidable circumlocution, so that the amount of mathematical formulæ required has been practically reduced to a few simple expressions easily understood by persons familiar with arithmetic.

The work is divided into thirteen chapters, each of which is intended to be a complete treatise on the subject to which it relates, and the whole to embrace all the essential facts pertaining to dynamic electricity.

The chronological order of electrical development has been followed pretty closely, thus not only giving a condensed history of the progress made in the science, but also showing the relations of each successive important invention to those which preceded and followed it. The style of the work is as clear as a due regard for the conciseness necessary in such a treatise will admit.

The different parts of the subject are taken up in the following order, a chapter being devoted to each. The voltaic battery, with definitions of the terms used; one-fluid cells; two-fluid cells, and battery formation; magnetism; electromagnetism; electric measurement; the dynamo and motor; electrolysis; electric storage; the relations of electricity to heat; the relations of electricity to light; the electric telegraph; and the telephone.

Prussian Schools through American Eyes. By JAMES RUSSELL PARSONS, JR. Syracuse. Bardeen. 8° \$1.

THE author of this book was recently United States Consul at Aix-la-Chapelle, and was employed by the authorities of the State of New York to make a report on the organization and methods of the Prussian schools, with a view to obtaining hints from them for the improvement of our own. Having been a school commissioner in New York State for some years, and being greatly interested in the public schools, Mr. Parsons took up the task assigned him with ardor and intelligence, and now gives us in this volume the result of his inquiries. The report is drawn up in the usual style of public documents, with little pretence of literary form, so that it is not so attractive to the reader as it might otherwise have been; but it presents a large amount of information concerning the Prussian schools in a form convenient for reference. It treats of the organization and government of the schools, the methods of discipline and of teaching, with some account of the buildings and apparatus, and gives a very full exposition of the courses of study. The normal schools are also dwelt upon at considerable length, and the mode of training teachers described.

Mr. Parsons is an admirer of the Prussian system, which he declares to be the best in the world; yet he sees that there is much in it which our people, accustomed to greater freedom and not

readily submissive to government drill, would not be willing to adopt. Two of the main points of superiority in the Prussian schools, as compared with those of New York, are, in his view, the compulsory education law, which is rigidly enforced, and the official courses of study for the various schools, which insure a higher average grade of instruction than is usual in New York. Mr. Parsons also calls attention to the fact that school commissioners in Prussia must be properly trained for their work, and must have served for a time as teachers before being appointed to the higher office; whereas in this country the main qualification of such officers is the ability to secure a majority of the votes in a popular election. These are, in his opinion, the points in which we might most advantageously imitate the Prussian system; but he also notices a few others, while in some respects he shows that our own schools are superior. The report may be heartily recommended to all who are interested in the subject.

AMONG THE PUBLISHERS.

PHOTOGRAPHIC amateurs will read with interest Ellerslie Wallace's paper on "Photographic Dark Rooms," in *Outing* for May.

— The *Home Journal* devotes an entire page of its issue of May 6 to what may be called a guide to London hotels, though the formality of a "Guide" is avoided, and the information is put in a style which renders it entertaining even to the stay-at-home tourist.

— The May 2 issue of *The Medical and Surgical Reporter*, Philadelphia, is the first to appear under the new editor, Edward T. Reichert, M.D. The paper has been enlarged from twenty-eight to forty pages.

— William Cushing, 19 Ware Street, Cambridge, Mass., has been employed during the last year in collecting brief biographical notices of Harvard graduates, which he hopes soon to publish under the title "Harvard Graduates Before 1860."

— John Wiley & Sons have in preparation a work on "Car Lubrication," by W. E. Hall of the Pennsylvania Railroad; "The Mechanical Engineer's Pocket-Book," by William Kent, M.E.; also "The Transitive Curve Field Book," by Clinton R. Howard, C.E.

— The Salem Press Publishing and Printing Company, Salem, Mass., will publish in June, "Salem Witchcraft in Outline," by Caroline E. Upham, a niece of Dr. O. W. Holmes. In August they will publish "Historic Storms," by Sidney Perley; an interesting account of the great storms, cold winters, hot summers, etc., from 1620 to the present.

— Ginn & Co. have just published "Business Book-Keeping," a manual of modern methods in recording business transactions by single entry. George E. Gay of the High School, Malden, Mass., is the author. The forms given in the book are taken from the methods of the best accountants, are well adapted to their purpose, and are presented in a manner that appears to be both practical and satisfactory.

— *Babyhood* for May contains an article on "Chronic Throat Troubles Resulting from Diphtheria and Scarlet Fever, and How to Prevent Them," by Dr. D. Bryson Delavan, which lays stress on the fact, not generally known, that a considerable proportion of catarrhal diseases of the throat and nose have their origin in one of the above complaints. Many other medical topics of interest to mothers are discussed under "Nursery Problems."

— We have received from C. W. Bardeen of Syracuse a small volume entitled "Apperception," which is intended more especially for teachers. It should have been entitled "Perception," for that is the subject of the book, and indeed the barbarous term "apperception" is nowhere used except upon the title-page. The main purpose of the author is to call attention to the fact that the perception of outward things is largely a matter of interpretation, every new object requiring to be classified and assigned its proper place in the general system of our knowledge. There is nothing new or striking in the book, but it may be suggestive to teachers

who have not been in the habit of attending to this aspect of our mental operations.

—Of the two numbers of the *American Journal of Psychology* recently issued, one completes the third, and the other begins the fourth, volume of that magazine. The first contains an interesting article on the attitudes of the insane ("Automatic Muscular Movements of the Insane," by Dr. Charles P. Bancroft, superintendent of the New Hampshire asylum), illustrated with a plate showing some typical ones. Mr. Herbert Nichols contributes the historical part of a continued article on the "Psychology of Time," and Dr. C. F. Hodge one on the "Recovery of Ganglion Cells after Electrical Stimulation." Besides the usual reviews and abstracts upon psychological literature ("Nervous System," Dr. H. H. Donaldson; "General Paralysis," Dr. Wm. Noyes; "Experimental"), the number contains a long and vigorous critique, by the editor, of Professor James's "Psychology." With this number is furnished also a complete index to authors of papers received, and a carefully made subject-index to the large amount of matter gathered in the review department. With the first number of the new volume, a change in the title-page and publisher (now J. H. Orpha, Clark University, Worcester, Mass.) has been made. The first article, by Dr. E. W. Scripture, is a very readable account of the arithmetical prodigies that have from time to time astonished the world of less ready reckoners, and of the methods by which their feats have been performed. The other leading article is a continuation from the previous number of Mr. Herbert Nichols's study of the psychology of time. The author first presents the results of his own long course of experimentation, a special phase of this difficult subject, and then makes exposition of an extremely plausible theory of his own with reference to how time is perceived and apperceived. The place of the usual reviews and abstracts is this time taken by four minor contributions, one upon "Cerebral Localization," by Dr. H. H. Donaldson, being a report of six lectures on cerebral localization delivered before the Boston Medico-Psychological Society in February and March of this year, and giving in convenient shape, and sifted of unnecessary detail, a summary of recent anatomical contributions to this important subject. Another is upon "Brain Models," and by the same author. The third is the first installment of a laboratory course in physiological psychology, by Dr. E. C. Sanford, in substance a course given in Clark University. The fourth article is the first of a series upon contemporary psychologists, by the editor, this time upon Zeller, and deals largely with his contributions to the psychology of religion. We are confidently assured that there is no thought of permanently displacing the reviews.

—The May number of the *Atlantic Monthly* contains a number of articles of interest to teachers. Chief among these is a paper by Professor Truman Henry Safford of Williams College, on the "Modern Teaching of Arithmetic." The author traces the teaching of arithmetic from the time of the Greeks and Romans to our own day, shows the great influence of Warren Colburn and his "First Lessons," and ends his paper with a long account of the Grube method and its adaptability to the present times and methods of instruction.

—The March number of the publications of the American Statistical Association contains "The Growth of Cities in Massachusetts," by Hon. Horace G. Wadlin; "Rate of Natural Increase of Population in United States," by Herman Hollerith; "The First Census of Massachusetts," by Hon. Samuel A. Green; "The Commercial Death Rate," by Albert C. Stevens; "Parliamentary Elections in Japan," by Theodore M. MacNair; Reviews and Notices: Reports of Bureaus of Labor Statistics; Notes on President Walker's Article on Statistics of the Colored Race; The Birth Rate in Europe during the Last Twenty Years; United States Census Bulletins; Reports of State Boards of Charities and Corrections; Health and Vital Statistics; Statistical Year-Book of Uruguay; Report of the Comptroller of the Currency; Municipal Finance, Price Statistics; Minor Notices.

—The May issue of *Psyche, a Journal of Entomology*, contains "A List of the Orthoptera of Illinois, — IV." (concluded), by Jerome McNeill; "A Supplementary Note on Diabrotica, 12-punc-

tata," by H. Garman; "Descriptions of the Preparatory Stages of Two Forms of *Cerura Cinerea* Walk.," by Harrison G. Dyar; "Two New Tachinids," by C. H. Tyler Townsend; "Edwards's Butterflies of North America;" "Packard's Forest-insects;" Personal Notes; and Proceedings of the Cambridge Entomological Club.

—Houghton, Mifflin, & Co. will publish immediately Mr. Fiske's work on the "American Revolution," in two volumes.

—T. Y. Crowell & Co. have just ready the third volume of Sybel's work on "The Founding of the German Empire." This volume is almost wholly occupied with events that occurred between 1848, when King Christian of Denmark died, and 1864, when the preliminaries of peace between Denmark and Germany were signed.

—G. P. Putnam's Sons have just ready, in the Questions of the Day Series, "The Question of Copyright;" the second edition, thoroughly revised and extended, of W. Swan Sonnenschein's "The Best Books," a list of the best available books in every department of literature; and a sketch of the life of Charles Darwin in the Leaders of Science Series.

—D. Appleton & Co. announce for early publication Baldwin's "Applied Psychology and Art of Teaching;" Herbart's "Psychology;" "A Descriptive Guide-Book to Canada," including accounts of the opportunities for sportsmen and tourists, by Charles G. D. Roberts; new editions of Appleton's "Dictionary of New York," "Summer Resorts," and "General Guide to the United States and Canada;" and "North America," Vol. XV. of Reclus's great work, "The Earth and Its Inhabitants."

—Hypnotism, which is now attracting such widespread attention, is considered in No. 3 of the Fowler & Wells Library, under the title of "How to Magnetize; or, Mesmerism and Clairvoyance, a Practical Treatise on the Choice, Management, and Capabilities of Subjects, with Instructions on the Manner of Procedure," by James Victor Wilson. The work closes with a chapter on animal magnetism as a therapeutic means, written by Dr. Fleming.

—The fifth volume of the Century Dictionary has just been issued. The fourth was issued six months ago, and it is expected to complete the book by the publication of the sixth and last volume in the autumn. The present volume brings the work down to Stro-, the words defined numbering now about 185,000. This number is the more surprising when it is considered that no effort has been made to swell the total, but, on the contrary, careful selection has constantly been exercised. It would have been easy, by the admission of self-explaining derivatives, and of "new words" from unauthoritative (unscientific and unliterary) sources, to have increased the list by many thousands. In the above enumeration transitive and intransitive uses of the same verb, and substantive and adjective uses of the same word, are counted but once (being entered under one head in the dictionary) instead of twice as in the older dictionaries (where they are entered separately as different "words"). The fifth volume is more distinctively literary in character than those that preceded it, owing to the greater proportion of literary words in R and S. It contains, however, many important scientific terms, as spectrum, spectroscope, Saturn, etc., and a glance at the pages will show many unusually interesting definitions, as under ship, rifle, shoe, relation, relief, run, rack, safe, star, steam-engine, stand, etc., with hundreds of exquisite engravings of art-objects. The bulk of the volume consists of the letter S, which (as far as Stro-) occupies 716 pages, with about 21,500 words. The entire letter will occupy 860 pages, being the largest in the dictionary.

—"Crustacea from the northern coast of Yucatan, the harbor of Vera Cruz, the west coast of Florida, and the Bermuda Islands," is the title of a paper by J. E. Ives, in the Proceedings of the Academy of Natural Sciences, Philadelphia, March 31. The crustacea treated of in this paper were collected for the greater part on the northern coast of Yucatan and in the harbor of Vera Cruz, during the early months of 1890, by the expedition in charge of Professor Angelo Heilprin, sent by the Academy of Natural Sci-

ences of Philadelphia to investigate the natural history of Yucatan and Mexico. The paper also includes a list of the crustacea collected upon the west coast of Florida in the spring of 1886 by Professor Heilprin and Mr. Joseph Willcox, under the auspices of the Wagner Free Institute of Science of Philadelphia, and the description of a new Isopod, collected by the Academy's expedition to the Bermuda Islands in 1888. It is remarkable that the shores of Yucatan and Mexico, portions of the American continent among the first to be discovered by Europeans, should be among the last to have their zoölogy investigated. Nothing whatever, with one or two isolated exceptions, has been known hitherto of the fauna of the shores of Yucatan, and very little of that of the eastern coast of Mexico. The material collected by the expedition has added considerably to the knowledge of this region.

— The late Richard A. Proctor, according to *Literary News*, was gifted with a remarkable memory. Thackeray was his favorite novelist, and he could repeat verbatim page after page of "The Newcomes;" so much in fact that the dear old Colonel became an unmitigated bore to his former friends.

— The officers for 1891-92 of the Boston Society of Natural History will be: president, George L. Goodale; vice presidents, William H. Niles, B. Joy Jeffries, Samuel Wells; curator, Alpheus Hyatt; secretary, Samuel Dexter; treasurer, Charles W. Scudder; librarian, Samuel Dexter.

— The Fiske range-finder, which was first described in these columns last year, has been very favorably received by the naval departments of several different countries, the remarkable results obtained by the exhaustive trials carried out on board United States war-ships having given a sufficient guarantee of the practical value of the instrument. In the American navy the range-finder was installed on board the "Baltimore," and from the extensive trials made with it there, during six months at sea, the writers of the official report state that it is accurate within three per cent on ranges up to 5,000 yards. In France, according to *Engineering*, the range finder has been mounted on board "Le Formidable," the flagship of the French Mediterranean fleet, and extensive trials were made in February last with the instrument to determine the distance between vessels having a relative motion of from 0 to 28 knots. Under these conditions the results were found to be accurate within five per cent. From experiments on fixed objects the commission in charge report that the instrument could be used by trained observers under the conditions of combat, and they remark that a specially valuable feature of the instrument is that it enables the observer to record the distance — to within a very small percentage — between forts or ships, before firing grows heavy. Difficulty in observation would, of course, be increased in a heavy seaway, but not so much as would the accurate pointing of the guns, so that the range-finder can be always relied on to give more accurate work than the guns. The com-

Publications received at Editor's Office,
April 27-May 2.

- AMMEN, D. The Old Navy and the New. Philadelphia, Lippincott. 553 p. 8°. \$3.
BROOKS, W. K. The Oyster. Baltimore, Johns Hopkins Press. 230 p. 12°.
D'ANVERS, N. The Story of Early Man (2d ed.). New York, Whittaker. 140 p. 12°. 40 cts.
D'ANVERS, N. The Life Story of Our Earth (2d ed.). New York, Whittaker. 185 p. 12°. 40 cts.
FINE, H. B. The Number-System of Algebra. Boston and New York, Leach, Shewell, & Sanborn. 181 p. 12°. \$1.
JONES, D. E. Elementary Lessons in Heat, Light, and Sound. London and New York, Macmillan. 280 p. 12°. 70 cts.
KEEP, R. P. The Essential Uses of the Moods in Greek and Latin. Set Forth in Parallel Arrangement. Boston, Ginn. 56 p. 16°.
NEW YORK, Fifth Annual Report of the Factory Inspectors of the State of. Albany, State. 673 p. 8°.
OTT, I. The Modern Antipyretics: Their Action in Health and Disease. Easton, Pa., Vogel. 52 p. 8°.
OUR LANGUAGE. Vol. I., No. 1. April, 1891. New York, F. A. Fernald. 8 p. 4°. m. 50 cts. per year.
PARSONS, J. R., Jr. Prussian Schools through American Eyes. Syracuse, Bardeen. 91 p. 8°. \$1.
ROOPER, T. G. Apperception; or, The Essential Mental Operation in the Act of Learning. Syracuse, Bardeen. 52 p. 12°. 50 cts.
TRELEASE, W. The Species of Epilobium Occurring North of Mexico. St. Louis, Nixon-Jones Co. Pr. 117 p. 48 pl. 8°.
VON MEYER, E. A History of Chemistry from Earliest Times to the Present Day. London and New York, Macmillan. 556 p. 8°. \$4.50.
WINCHELL, N. H. & H. V. Iron Ores of Minnesota (Bulletin No. 6. Geol. and Nat. Hist. Survey of Minnesota). 430 p. 8°. Geol. Map and 44 pl.

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mission consider the instrument will be particularly useful at night, as the mere flash of a gun will be sufficient to give the range of the vessel firing it. Even more satisfactory experiments were made on board "Il Terribile," of the Italian navy at Spezzia last month, when it was found that, with the ship moving, the distance of a moving target was ascertained with an error of only 1.3 per cent per 1,000 metres range.

—A series of experiments in treating corn with various substances to prevent its being taken by the striped squirrels was carried on at the Iowa Experiment Station last spring. The corn was treated in the following manner: Smoked with meat in an ordinary smoke-house until the kernels were black; smoked in a barrel with tobacco dust; smoked over night in strong decoctions of tobacco and of quassia chips; soaked in a dilute carbolic-acid mixture, in strong alum water, in salt water, and kerosene. The squirrels would take the corn treated in any of these ways, though the carbolic-acid treatment and the smoking with tobacco made

the corn distasteful, and when in the vicinity of other grain would be left till the last. The best remedy seems to be to harrow the ground immediately after planting to cover the planter tracks, and then to scatter corn about the border of the fields and in the vicinity of the squirrel holes as soon as the corn begins to come up.

—"Schliemann was thirty-four years old," says the Chicago Tribune, "before he knew a word of Greek, and it was not until he was forty-one that he began the study of archæology, in which he was destined to achieve so much distinction. By the way, there was an interesting clause inserted in the marriage contract between the late Dr. Schliemann and the Greek girl whom he made his second wife, to the effect that she should improve her knowledge of Homer by learning and reciting fifty lines of the Iliad nightly. Schliemann, when telling the story to his friends, always said that neither tears nor entreaties ever induced him to let her off a single line."

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